PE 7053
TWO - PHASE FLOW MODELING
(Spring 2013 , TTh 9:30 - 10:45 , M4)

Instructor: Dr. Ovadia Shoham

Office: SH 2295 x 3255

Office Hours: TTh: 11:00 - 12:00

Bulletin Description:

Theoretical treatment of two-phase flow. Two-phase flow phenomena and the recent modeling approach. Review of the early "black box" general models. Flow pattern transition prediction and flow pattern modeling for vertical, horizontal and inclined pipes and unified modeling. Introduction to transient flow. Application examples.

Text Book: "Mechanistic Modeling of Gas-Liquid Two-Phase Flow in Pipes" by O. Shoham, SPE, 2006.

Course Outline: Attached

Course Grading:

Homework	10%
Midterm Exam	30%
Final Exam	60%

Course Conduct: Rules concerning academic conduct are available in Dean office.

SCOPE

The objectives of this class are twofold:

- To provide insight and understanding of two-phase flow phenomena and
- To develop analytical tools for either designing two-phase flow systems or conducting research in this area.

The traditional approach for two-phase flow prediction has been the empirical approach. The approach was based on development of empirical correlation from experimental data. This course presents the recent approach in which mathematical mechanistic models are developed, based on the physical phenomena, for the prediction of two-phase flow behavior. The models can be verified and refined with limited experimental data. However, as these models incorporate the physical phenomena and the important flow variables, they can be extended to different operational conditions and enable scale-up with significant confidence.

The first part of the course includes an introduction on two-phase flow phenomena and a review of the early "black box" flow pattern independent models. The main part of the course is a detailed study of models for predicting flow pattern transition boundaries, and separate models for each flow pattern for the prediction of the flow characteristics, such as the liquid holdup and the pressure drop. The analysis is carried out for vertical flow, horizontal and near horizontal flow and inclined flow.

COURSE OUTLINE

I. FUNDAMENTALS OF TWO-PHASE FLOW

1.1 Two-Phase Flow Occurrence and Applications
1.2 The Modeling Approach
1.3 Two-Phase Flow Variables
1.4 Two-phase Flow Fundamental Phenomena
1.5 Flow Pattern Definitions and Classifications
1.6 Two-Phase Flow Computation Algorithm (x)

II. EARLY BLACK BOX MODELS

2.1 Homogeneous No-Slip Model
2.2 Separated Model (x)
2.3 Similarity Analysis (x)
2.4 Drift-Flux Analysis (x)

III. FLOW IN PIPELINES

3.1 Pipeline Empirical Correlations (x)
3.2 Flow Pattern Prediction in Pipelines
3.3 Stratified Flow Modeling
3.4 Slug Flow Modeling
3.5 Pipeline Overall Model and Evaluation of Methods

IV. FLOW IN WELLBORES

4.1 Wellbores Empirical Correlations (x)
4.2 Flow Pattern Prediction in Wellbores
4.3 Bubble Flow Modeling
4.4 Slug Flow Modeling
4.5 Annular Flow Modeling
4.6 Wellbore Overall Model and Evaluation of Methods

V. FLOW IN INCLINED PIPES

5.1 Flow Pattern Transitions in Inclined Pipes
5.2 Unified Modeling for Flow Pattern Prediction
5.3 Unified Modeling for Upward Slug Flow (x)
5.4 Unified Two-Dimensional Modeling for Stratified Flow (x)
5.5 Unified Overall Model for Pipelines and Wellbores